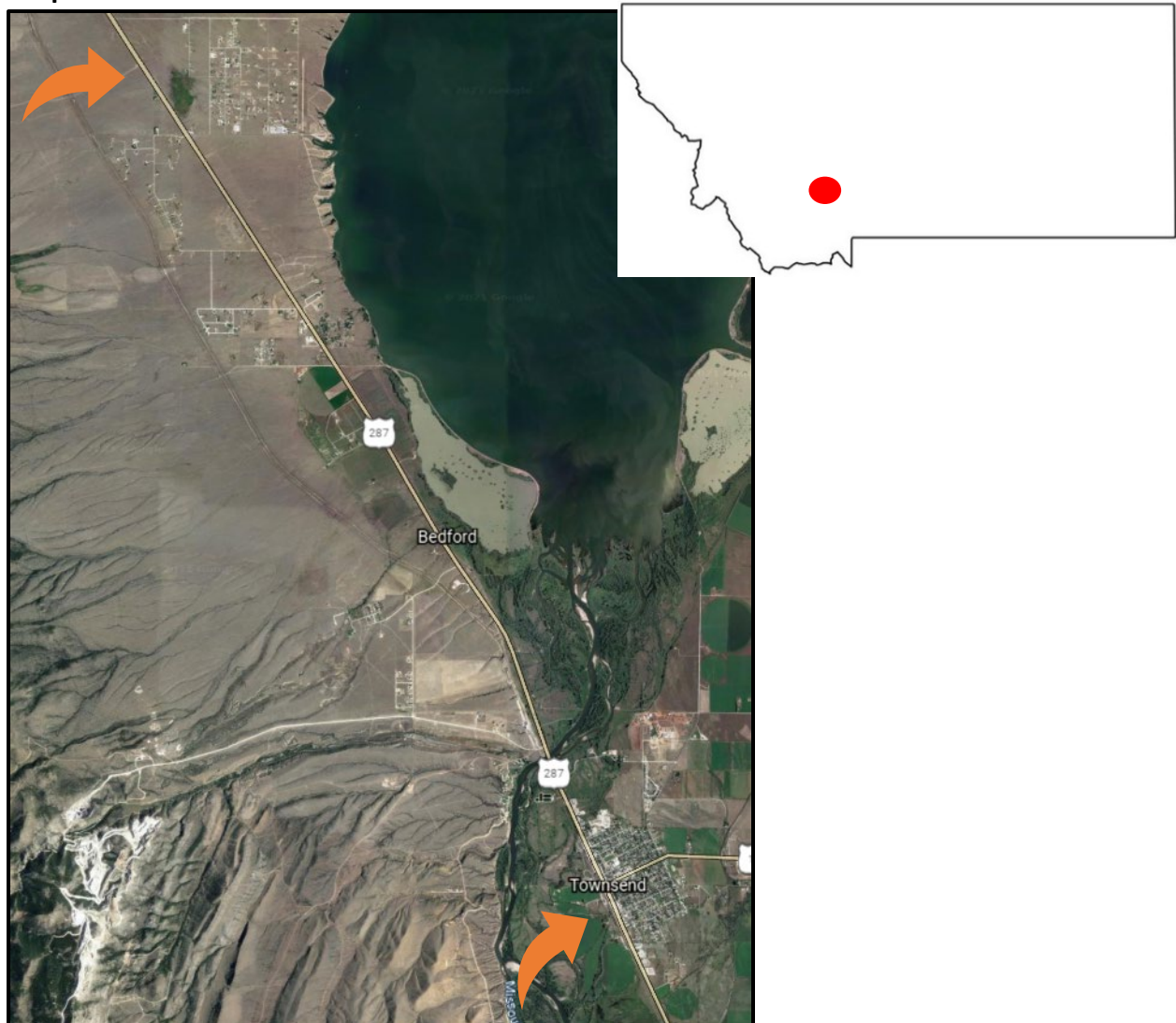


**Experimental Feature Evaluation
 July 2023**

Experimental Feature:	Diamond Road Smoothing
Location:	Butte District, Broadwater County, US Hwy 287/12, RP 68.00 – 78.10
MDT Project Name:	Townsend – North
MDT Project Number:	NH 8-4(79)68[9470]
Experimental Project Number:	MT-21-02
Principle Investigator:	Chad DeAustin, Experimental Project Manager, (ExPM)
Technical Contact:	Miles Yerger, Pavement Design Engineer
Construction Date:	August 2021
Inspection Dates:	July 2022, June 2023

Map



Feature Description & Outline

Road smoothing using a diamond grinding mill is a practice of grinding the surface of a roadway to eliminate bumps and rutting while maintaining a proper profile. The Diamond Road Smoother is a truck and trailer combo that moves down the roadway intaking information with averaging level arms and outputting a smooth road via the diamond grinding diamond impregnated bits on an eight-foot milling head. MDT chose the Townsend-North job to test this equipment as the road was structurally in good condition but was experiencing rutting and fair ride condition.

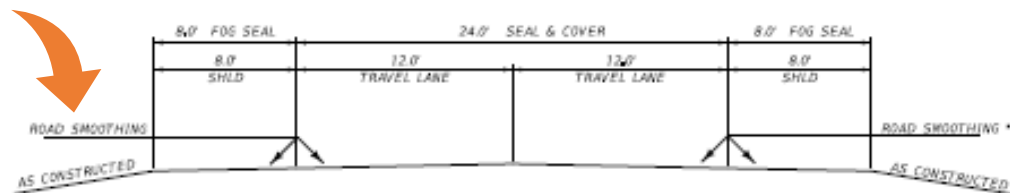
Below are links to the company's website and a few resources of the equipment and construction projects using the equipment.

<https://diamondroad.com/products/diamond-road-smoother/>

<https://www.youtube.com/watch?v=Y3FwxwlgS1Kc>

<https://www.youtube.com/watch?v=AZ2VJaJaCEA&t=15s>

TYPICAL SECTION NO. 5 MAINLINE



Above for an example of a typical section taken from the project plan set that includes the road smoothing call out (arrow). A more detailed description can be found in the 'Summary' page of the plans which breaks down total distance (5.2 miles) for the contracted road smoothing work. To complete each travel lane, the semi-trailer combo needed to make 2 passes in each lane. After the road smoothing was complete a chip seal was applied to protect the new surface. See below for the special provisions included in this contract for the road smoothing item.

32. ROAD SMOOTHING [NH 8-4(79)68]

A. Description. This work consists of asphalt pavement smoothing by the means of diamond milling (Road Smoothing) at locations shown in plans or as directed by the Project Manager.

B. Materials. None

C. Construction

1) Equipment. The contractor shall provide equipment utilizing diamond tipped teeth mounted to a self-contained, highly mobile machine specifically designed for grinding and texturing asphalt pavement.

a) Equipment must include dual parallel independent support arms that carry the cutting drum at the outer extent of the drum. The minimum length of the support arms shall be 32 feet.

b) The cutting drum must be tapered on the outer edges to eliminate a vertical edge. A vertical edge is not acceptable, grind a sufficient width until a vertical edge is eliminated.

c) Equipment must be capable of moving at highway speeds between grinding and texturing pavement.

2) Pavement Surface Smoothing Requirements.

a) Provide a uniform finished texture.

b) Perform smoothing in a longitudinal direction. Begin and end smoothing at lines normal to pavement centerline.

c) Taper in and out of smoothing area to provide a smooth transition.

d) Do not cause damage to underlying asphalt pavement.

e) Maintain existing cross slope drainage and existing roadway crown.

f) Provide a uniform transverse slope of the asphalt pavement with no depression or misalignment of slope greater than ¼ inch in 10 feet when measured with a 10-foot straight edge

3) Remove and dispose of all existing bituminous or concrete materials in accordance with subsection 202.03.3.

4) Existing IRI measurements are available upon request.

5) The target values for this contract are as follows:

a) Any area with an existing IRI of 100 inches/mile or greater, improve to an IRI of 90 inches/mile or less.

b) Any area with an existing IRI between 100 inches/mile and 90 inches/mile, improve to an IRI of 70 inches/mile or less.

c) Smooth passing lanes regardless of IRI to remove existing rutting ensuring existing ride values are maintained or improved.

Evaluation Procedures & Schedule

The measures of effectiveness prevalent with this feature are:

- Construction practices (constructability, construction time, cost effectiveness, etc.),
- Visual inspection of the smoothed and chip sealed surface,
- Driven inspection of the smoothed and chip sealed surface,
- Comparison of ride and rut data from prior to construction, after construction and annually.

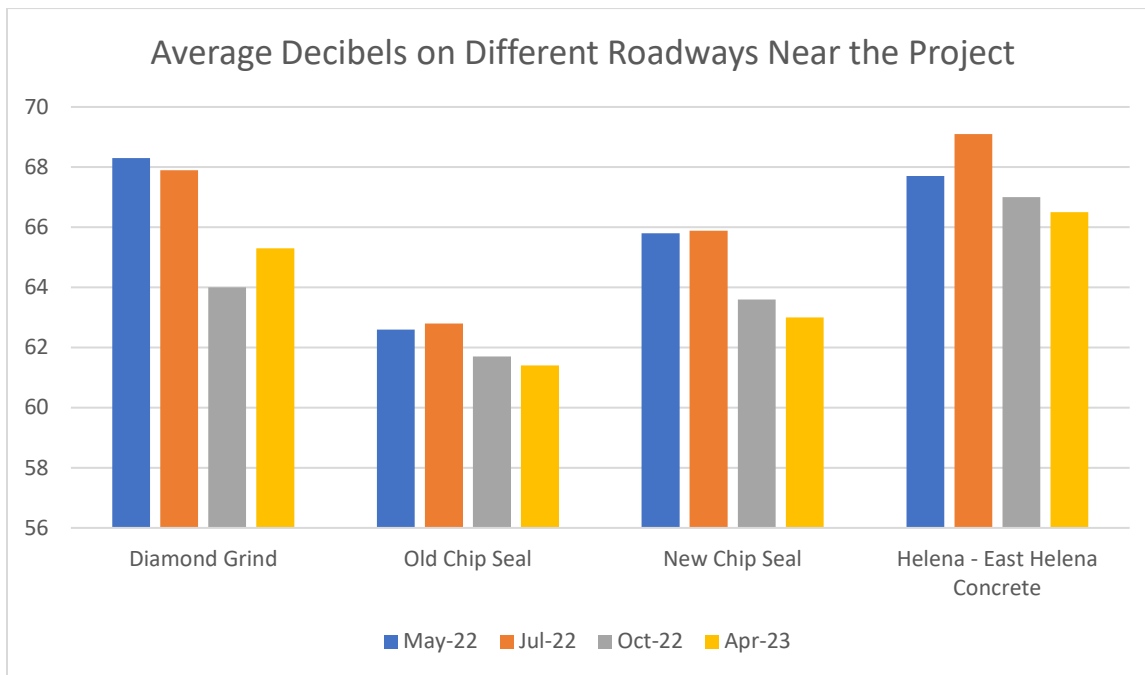
In accordance with MDT's Experimental Features Procedures, the Experimental Project Manager will monitor and report on performance for a minimum of five years annually. This includes delivery of a work plan, construction report, annual reports, and final project report.

2021: Installation/Construction Report
2022-2025: Annual Inspections/Evaluation Reports
2026: Final Evaluation/Final Report

A dedicated [webpage](#) provides all reporting for the experimental feature.

2023 Inspection – June

As noted in the construction documentation, the texture after grinding was less than desirable. The chip seal applied after the grinding slightly reduced the noise. However, MDT determined that a noise evaluation was needed. Below are the results from the 2023 noise evaluation. The old chip seal is a section of roadway directly adjacent to the Diamond Grind section and the new chip seal is a section within the project limits that had no Diamond Grind corrective action. While the Diamond Grind data results show a louder average, it is similar to the concrete between East Helena and Helena and slightly higher average than the new chip seal section. The results are from 4 different dates and are average decibels of approximately a mile of different pavement treatments.



The noise measured for the Diamond Grind sections has decreased overall through the evaluation. While this is an improvement, the graph shows the average indicating there are areas that louder. The monitoring of this will continue and corrective action may still be needed.



↑ RP 70.0, view south. This section is in the road smoothed section. Some wheel path wear can be seen.



↑ RP 70.0, close-up view of the surface texture.



↑ RP 72.0, view south. This is in the non-road smoothed section. Wheel path wear is also seen in this section.



↑ RP 72.0, close-up view of the surface texture.

Construction Documentation – August 2021



↑ Diamond grinding operation in action. The yellow level arms take in information and feed it to the on-board computer that controls the mill head.

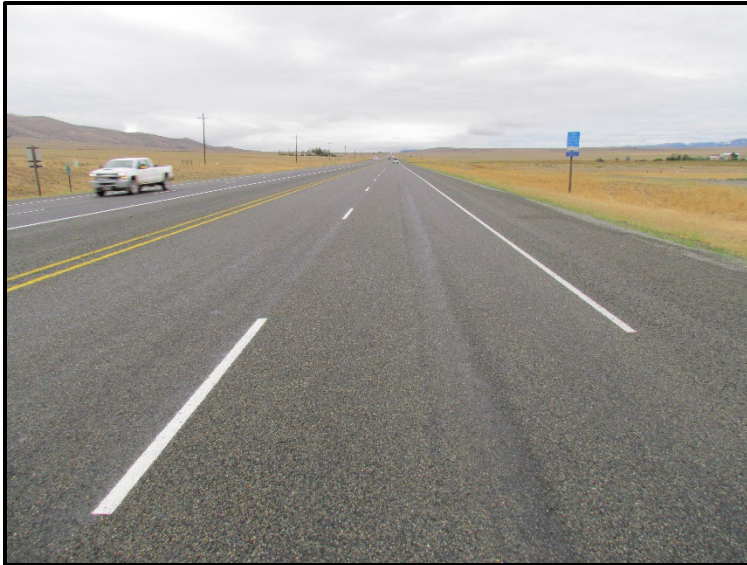


↑ Behind semi, there were two brooms cleaning the roadway.



↑↓ Section of roadway with completed road smoothing.





← Example of roadway surface after chip seal.



← Close-up of chip seal surface.



← Close-up of an area that the chip emulsion bled through the chips. This happened in multiple locations throughout the project.

Lane	Pre-Ride (IRI)	Final Ride (IRI)	Length (miles)
NBDL (RP 68-71.5)	59.69	35.66	3.5
NBPL	77.47	35.81	2.1
SBDL (RP 68-71.5)	60.45	33.66	3.5
SBPL	81.42	36.40	2.2

Per MDT EPM, Gary Berg, the smoothing area was changed from the plans. The final areas were RP 68 to 71.5 and RP 76.4 to 78.1 minus the PCCP section in Townsend (RP 77.57-77.58). As seen in the table above, the road smoothing operation greatly improved the overall ride of the project and removed significant wheel path ruts. However, the teeth of the mill created a less than ideal texture caused in part by the equipment being operated at a speed faster than ideal. The texture increased noise heard within the vehicle significantly. Butte District Construction noted this and had concerns of how well the chip seal would adhere to the uneven surface. It was decided to monitor these areas of concern and address them in the summer of 2022 if problems arise.

To monitor wear and get comparative data, the Pavement, Environmental, and Research sections have created a decibel testing monitoring schedule for the project and data will be included in this report when available.

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